



New Insights into the Creation of High-Mobility Two-Dimensional Electron Gas at Oxide Interfaces: Control of Interfacial Redox Reactions by an Electron Sink

Chen, Yunzhong; Green, R.J. ; Trier, Felix; Christensen, Dennis Valbjørn; Sutarto, R. ; He, F.; von Soosten, Merlin; Zhang, Y.; Linderoth, Søren; Pryds, Nini

Publication date:
2016

Document Version
Peer reviewed version

[Link back to DTU Orbit](#)

Citation (APA):
Chen, Y., Green, R. J., Trier, F., Christensen, D. V., Sutarto, R., He, F., von Soosten, M., Zhang, Y., Linderoth, S., & Pryds, N. (2016). *New Insights into the Creation of High-Mobility Two-Dimensional Electron Gas at Oxide Interfaces: Control of Interfacial Redox Reactions by an Electron Sink*. Abstract from 23rd International Workshop on Oxide Electronics, Nanjing, China.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

New Insights into the Creation of High-Mobility Two-Dimensional Electron Gas at Oxide Interfaces: Control of Interfacial Redox Reactions by an Electron Sink

Y. Z. Chen^{1*}, R. J. Green,² F. Trier,¹ D. V. Christensen,¹ R. Sutarto,³ F. He,³ M. von Soosten,¹ Y. Zhang,^{1,4} S. Linderoth,¹ N. Pryds¹

¹ Department of Energy Conversion and Storage, Technical University of Denmark, Roskilde, Denmark

²Quantum Matter Institute, Department of Physics and Astronomy, University of British Columbia, Vancouver, Canada

³Canadian Light Source, Saskatoon, Canada

⁴Institute of Physics, Chinese Academy of Sciences, Beijing, China

*E-mail: yunc@dtu.dk

Redox reactions on the SrTiO₃ (STO) surface provide a new opportunity to create two-dimensional electron gas (2DEG) at all oxide interfaces by forming oxygen vacancies.^[1] Herein, we report that an insulating buffer layer of La_{1-x}Sr_xMnO₃ (LSMO, 0≤x≤1), grown epitaxially on unit cell (uc) scale, can strongly suppress the formation of oxygen vacancies for typical metallic interfaces between STO and various insulating overlayers. Remarkably, for heterostructures with sizeable band-offsets, the LSMO buffer layer can result in modulation-doping^[2] of the interfacial 2DEGs, where large enhancements in electron mobility as well as sharp metal-insulator transitions are achieved upon tuning the thickness of the buffer layer. Moreover, novel charge and orbital reconstruction at the modulation doped interface is also revealed by resonant X-ray reflectivity measurements, where the buffer layer play the role as an electron sink. On the other hand, for heterointerfaces with negligible band-offsets, the conduction is dominated by redox reactions and the carrier mobility is always lower than 1000 cm²V⁻¹s⁻¹ at 2 K. The insertion of the electron sink layer turns out to be one of the most effective approaches to achieve high-mobility and low carrier density 2DEGs at oxide interfaces.

Preferred Type of Presentation: Oral

Reference:

[1] Chen, Y. Z. *et al. Nano Lett.* **11**, 3774 (2011).

[2] Chen, Y. Z. *et al. Nature Mater.* **14**, 801 (2015).